Before the
Federal Communications Commission
Washington, D.C.

In the matter of:

An Inquiry into the Commission's	)	
Policies and Ruled regarding AM	)	MM Docket No. 93-177
Radio Service Directional Antenna	)	RM-7594
Performance Verification	)	

Comments of Suffa & Cavell, Inc.

Introduction

Suffa & Cavell (S&C), a consulting engineering firm, hereby submits its comments in the above captioned proceeding. S&C regularly provides engineering services to numerous radio broadcasting clients. The principals of S&C have combined experience in station ownership, management, technical operations, and engineering, as well as field engineering for the Federal Communications Commission. Each has been involved in the design, tuning, and measurement of directional antenna systems. Each of the principals has conducted numerous allocation studies on behalf of client stations, has been involved in antenna system design and adjustment, and has personal knowledge of technical, financial and operational matters involving AM stations. The predecessor firm to Suffa & Cavell, Inc. (Lahm, Suffa & Cavell, Inc.) was one of the group of petitioners that requested this Inquiry.

In the Notice of Inquiry, the Commission seeks comments on whether revisions should be made to the AM broadcast Rules that govern the adjustment and verification of AM directional antenna systems. Those rules are intended to ensure that AM directional antennas operate in the manner in which they are designed to prevent interference between stations. We hereby respectfully submit our comments addressing those matters.

Summary of Comments

We support a complete overhaul of the Directional Antenna Performance Rules. In the past 40 years, substantial technical advances have been made in the techniques employed to design and adjust AM arrays, as well as the instrumentation employed to maintain those antenna systems. Given these advances, Suffa & Cavell now believes that instrumentation internal to the antenna array (i.e. the antenna monitoring system) can provide the most accurate evaluation of directional antenna systems, which will lead to a reduction of interference between AM radio stations. With appropriate safeguards, modern instrumentation and numerical antenna analysis methods can provide an accurate and reliable means of verifying the performance of AM directional antenna systems. Therefore, we support the elimination of the requirement for routine field strength measurements and proofs of performance as described in the present Rules. Instead, we advocate the use of appropriate internal measurements and calibration of the antenna monitoring system to establish compliance with the Commission's Rules.

Adoption of revised Rules will substantially reduce costs to AM broadcast stations, both for construction and routine compliance with the Rules. By reducing the technical and financial burden, it is more likely that Commission licensees will invest the resources necessary to properly maintain directional antenna systems, thereby achieving the Commission's goal of interference reduction.

S&C believes that the revision of the antenna performance Rules will serve to complete the modernization of the AM Rules begun in MM Docket 87-267, which overhauled the general allocation rules.

Commentary on the Proposals

The Commission indicated that it is initiating a broad inquiry into AM antenna design and performance. Four specific areas were mentioned; each will be discussed herein.

1) Instrumentation necessary for monitoring AM antenna system performance. S&C believes that equipment must be employed to monitor appropriate technical parameters related to the performance of AM directional antenna systems. This equipment must provide indications of the relative phase and amplitude relationships of the RF energy flowing in each element of the directional antenna system. Traditionally, the current flow in each antenna element has been measured by sampling the phase and amplitude of current flowing in each tower base (by means of a non-intrusive toroidal pickup) or at some location on the tower structure itself (by means of a single turn pickup loop). The current samples so derived are fed by coaxial cable to a phase monitor, which provides an indication of the relative current and phase, referenced to one tower in the array. Our experience is that both toroidal transformers and sample loops provide accurate and reliable indications of the antenna system performance. However, compensation for the capacitance of lines which cross the base insulator must be accounted for in performing numerical analysis of towers employing base current sampling.

Present day current monitoring equipment is reliable and accurate to within a small fraction of a degree of phase and a similar percentage of current ratio. Modern instrumentation can be constructed to operate in a reliable and accurate fashion without need for routine factory calibration. In fact, with present technology, it is possible to perform zero-crossing detection for phase sampling purposes. Reliable amplitude sampling is also possible.

We urge the Commission to adopt standards that allow for future changes in technology. While past methods of measuring antenna system performance has used relative current ratios and phase relationships, it is possible to sample the RF base voltage applied to a tower. The FCC Rules should allow for flexibility in the instrumentation employed, provided that the equipment is proved to be reliable and accurate.

With respect to deriving antenna current or voltage samples, modern numerical techniques allow for computation of the expected current at any location on a tower, and the voltage at the tower base. We have found that reliable samples may be obtained through use of loop sampling on the tower as well as base current sampling by toroidal transformers. We urge the Commission to require the use of equal-length coaxial sampling lines and identical sampling units on each tower. In the event that advances in instrumentation allow use of conductors other than coaxial cable between tower base and monitoring unit, the Commission should permit a licensee to employ such units provided that an appropriate demonstration is made as to the accuracy of the unit.

The licensee should be required to conduct a "system calibration", or "proof of performance" of the antenna parameter monitoring system upon installation, if major changes in indicated parameters occur, and at such times as major repairs are undertaken. Such measurements should not be necessary for routine replacement of components with identical components.

2) Field Measurements. S&C recommends that the Commission eliminate requirements for routine field strength measurements as part of a proof-of-performance.

The experience of this office, and our colleagues, is that modern numerical modeling techniques can accurately predict the performance of medium-wave directional antenna systems. With accurate measurement of the sampling lines and monitoring equipment, we have found that most antenna systems can be adjusted within standard pattern limitations on the first attempt. In fact, such an adjustment on this basis is often far more reliable than the making of field strength measurements. More time and money is expended in trying to "prove", through field measurements, that the array is properly adjusted than is expended in the initial array setup and adjustment.

We believe that elimination of field strength measurements will eliminate sources of ambiguity in the proof-of-performance process. With internal measurements to the array and monitoring system, the entire environment is under the control of the licensee and its engineers. When making field measurements, there are numerous outside factors, such as power lines, buildings, vehicles, and towers that influence the field readings, making them unreliable. Measurements on high-gain antenna systems taken across a river or other water body are influenced by the change in dielectric constant at the waters' edge and refraction of the radio signal, leading to incorrect conclusions. Further, field strength measurements, even at the same location, are subject to seasonal and other environmental variations.

We believe that there are some individuals that will not support a radical move to eliminate field strength measurements. Should the Commission elect to retain field strength measurement requirements, we urge that the Commission allow the option to submit a field-strength proof of performance only if the licensee elects not to upgrade the monitoring system to modern standards, or take advantage of the new adjustment procedure. The Rules should clearly allow the licensee the option to use new and modern techniques to prove antenna performance.

The elimination of field strength measurements will also eliminate a substantial cost and ongoing maintenance burden to AM licensees. Where an antenna system proof-of-performance and adjustment has, in the past, involved consulting costs of $20,000, or more, adoption of our recommendations can reduce that figure to $5,000, or less, a number comparable to FM directional antenna performance measurements.

We also anticipate that there may be comments that suggest retaining field strength measurements for purposes of conducting groundwave allocation studies. We urge the Commission to consider eliminating entirely the use of measured contours in groundwave allocation studies. Such measurements are unreliable for prediction of interference, particularly if the applicant chooses to make measurements in dry, hot seasons when the conductivity is less (which is anathema to the Commission's desire to reduce interference). Further, substantial costs are involved in searching the Commission's files for existing measurements to submit as part of an allocation study. Although unreliable as an accurate predictor of ground conductivities, use of FCC Map M-3 and its digital counterpart would allow all stations to be considered on an equal basis.

3) Use of theoretical, rather than measured, parameters. S&C urges the Commission to adopt rules allowing flexibility in the computational routines used to predict antenna performance. It is well known in the industry that current flow in antenna towers are generally not sinusoidal, particularly in low power towers in tight directional antenna systems. The Commission's computation routines assume sinusoidal current flow.

As noted above, numerical methods allow accurate determination of the current flow in a tower by properly accounting for mutual coupling between the towers. Our experience has shown great accuracy for these methods, even in large, tapered towers.

Some amount of error is acceptable. Because of the tolerance factors built into the standard pattern computation routines, we believe that small inaccuracies will not result in objectional interference.

Although present day models, such as Mininec and NEC, provide good prediction of antenna performance, the Commission should not foreclose the possibility of future, more accurate, models becoming available. Thus, we believe that a particular algorithm should not be adopted as part of this revision.

Finally, we wish to comment that most, if not all, technical service contractors and consulting firms employ computers capable of performing the calculation required for numerical anaylsis. Thus, the issue of computational technology is not pertinent.

4) Reradiation. In our experience, the issue of reradiation is overblown. In general, it has been our experience that the only reradiators of significance are those in or immediately adjacent to the array, such that significant amounts of energy are coupled into the towers. We are intimately familiar with situations where excessive sums of money have been spent on detuning far-field reradiators in an attempt to make the measured field strength readings come out "right". For interstation interference situations, the energy reradiated from these objects is simply insignificant.

Thus, we see no reason that the Commission should continue to hold station licensees hostage to situations beyond their control. Within the array itself, and the first few hundred feet from the array, it is essential that structures taller than 1/10 wavelength be detuned since such structures will affect the actual antenna pattern. Beyond a few hundred feet, reradiating structures tend only to result in local influence of groundwave field strength readings.

Beyond that, the techniques employed for detuning towers alter the current flow in the structure to reduce the radiated field on the ground. No consideration is given to the field at higher elevation angles. Although there is little energy in these structures (resulting in little radiated field), the influence will be felt in the skywave signal.

Conclusions

We commend the Commission for the priority it has recently placed on improving AM operations. We now believe that the Commission should complete its task of improving the process of adjusting directional antenna systems and minimizing burdens on the licensees. We recommend that the Commission eliminate the need for routine field-strength measurements in the adjustment of directional antenna systems.

Respectfully submitted, October 29, 1993 by:

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Certificate of Service

I, William P. Suffa, certify that copies of these comments were sent by first class mail on this date to the engineering firms of duTreil, Lundin & Rackley, Inc.; Hatfield & Dawson Consulting Engineers, Inc.; Moffett Larson & Johnson, Inc.; and Silliman & Silliman.

William P. Suffa

October 29, 1993